

PRE-APPEAL BRIEF REQUEST FOR REVIEW

Docket Number (Optional)

5649-1277

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Typed or printed name Michele P. McMahan

Application Number

10/801,208

Filed

03/16/2004

First Named Inventor

Kwang-hee Lee

Art Unit

2822

Examiner

Thanh Y. Tran

Applicant requests review of the final rejection in the above-identified application. No amendments are being filed with this request.

This request is being filed with a notice of appeal.

The review is requested for the reason(s) stated on the attached sheet(s).

Note: No more than five (5) pages may be provided.

I am the

☐ applicant/inventor.☐ assignee of record of the entire interest.
See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed.
(Form PTO/SB/96)☒ attorney or agent of record.
Registration number 40,493☐ attorney or agent acting under 37 CFR 1.34.

Registration number if acting under 37 CFR 1.34 _____



Signature

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Typed or printed name

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Telephone number

October 2, 2006

Date

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 1 forms are submitted.

This collection of information is required by 35 U.S.C. 132. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11, 1.14 and 41.6. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop AF, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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**RESPONSE UNDER 37 C.F.R. § 1.116
EXPEDITED PROCEDURE
EXAMINING GROUP 2822**

Attorney's Docket No. 5649-1277

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Kwang-hee Lee et al.

Serial No.: 10/801,208

Filed: March 16, 2004

For: METHODS OF MANUFACTURING SEMICONDUCTOR DEVICES HAVING A
RUTHENIUM LAYER VIA AUTOMATIC LAYER DEPOSITION

Examiner: Thanh Y. Tran

Group Art Unit: 2822

Confirmation No.: 2034

Date: October 2, 2006

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P.O. Box 1450

Alexandria, VA 22313-1450

**REASONS IN SUPPORT OF APPLICANTS'
-- PRE-APPEAL BRIEF REQUEST FOR REVIEW**

This document is submitted in support of the Pre-Appeal Brief Request for Review filed concurrently with a Notice of Appeal in compliance with 37 C.F.R. 41.31 and with the rules set out in the OG of July 12, 2005 for the New Appeal Brief Conference Pilot Program.

It is not believed that an extension of time and/or additional fee(s) are due. If any additional fee or extension of time for this request is required, Applicants request that this be considered a petition therefor. The Commissioner is authorized to charge any additional fee which may be required, or credit any refund, to our Deposit Account No. 50-0220.

REMARKS

Applicants hereby request a Pre-Appeal Brief Review of the pending rejections. Claims 1-3, 9-12 and 14 stand finally rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication No. 2002/0001860 to Kweon et al. ("Kweon") in view of U.S. Patent Publication No. 2004/0175845 to Molla et al. ("Molla"). Claims 4-6 and 7-8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Kweon, Molla and U.S. Patent Publication No. 2005/0020060 to Aaltonen et al. ("Aaltonen"). Claim 13 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Kweon, Molla and U.S. Patent No. 6,656,784 to Pakr ("Pakr"). Each of these rejections should be withdrawn for at least the reasons set forth below.

I. **Claim 1 is Patentable Over Kweon and Molla**

Independent Claim 1 recites:

1. A method of fabricating an electrode for a microelectronic device, the method comprising:

forming a ruthenium seed layer using atomic layer deposition on a semiconductor substrate;

forming a main ruthenium layer on the ruthenium seed layer; and

patterning the main ruthenium layer and the ruthenium seed layer to form the electrode.

The Final Action states that Kweon discloses all of the recitations of Claim 1 except for the seed layer being a ruthenium seed layer, and that it would have been obvious to modify Kweon to include the ruthenium seed layer of Molla. Applicants respectfully submit that the rejection of Claim 1 should be withdrawn for at least three independent reasons.

A. Kweon and Molla Fail to Disclose the "Patterning" Recitation of Claim 1

The Final Action states that layer 28 of Kweon comprises a "main ruthenium layer", that layer 26 of Kweon comprises a "seed layer", and that Kweon discloses "patterning the main ruthenium layer and the . . . seed layer to form the electrode" as recited in the last clause of Claim 1. (Final Action at 2). While Kweon does disclose a seed layer 26 and a ruthenium layer 28, Kweon does not state that these layers are patterned as recited in Claim 1. Instead, FIG. 2D of Kweon shows that the layer 28 is deposited within a contact hole and maintains its as-deposited shape. The seed layer 26 of Kweon likewise is not "patterned to form the electrode" as recited in Claim 1, but instead is selectively oxidized to form oxidized seed layers 26A that act as an insulating layer (and hence clearly are not part of the lower electrode). (See Kweon at ¶ [0022] and FIG. 2E). Thus, as the cited references fail to disclose the "patterning" recitation of Claim 1, the rejection of Claim 1 should be withdrawn.

The Examiner argues based on the dictionary definition of "pattern" that Kweon discloses the "patterning" recitation of Claim 1. (Final Action at 9-10). However, even using this definition of the word "pattern" it is clear that layers 26 and 28 of Kweon are neither "a form or model proposed for imitation" nor "something designed or used as a model for making things." Instead, layers 26 and 28 of Kweon are constituent layers of a semiconductor

device. More importantly, what Claim 1 recites is first "forming a main ruthenium layer on the ruthenium seed layer" and then "patterning the main ruthenium layer and the ruthenium seed layer to form the electrode." It is simply indisputable that Kweon does not disclose (1) first forming a main ruthenium layer and then patterning both the main ruthenium layer and the ruthenium seed layer or (2) patterning a main ruthenium layer and a seed layer to form an electrode as recited in Claim 1. Thus, for each of the above reasons, the rejection of Claim 1 should be withdrawn.

B. Kweon and Molla Would Not Be Combined in the Manner Suggested

Applicants also respectfully submit that a person of skill in the art would not have been motivated to combine Kweon and Molla in the manner suggested in the rejection of Claim 1. Molla discloses a method of forming a magnetic random access memory device. (Molla at ¶ 0001). Molla teaches that a first seed layer 20 is provided "to enable the flux concentration layer (which is subsequently formed) to be electrolessly plated within the opening 16 since the flux concentrating layer cannot be electrolessly deposited directly on the first barrier layer." (Molla at ¶ 0011). Thus, in Molla, the ruthenium seed layer appears necessary to allow deposition of a flux concentrating (i.e., magnetic cladding) layer during a later electroless plating step. The Examiner argues that it would have been obvious to modify Kweon to use a ruthenium material for the seed layer as taught by Molla "for enabling any flux concentrating layer to be electrolessly plated" or for "forming an electrode layer or activation layer for the device." (Final Action at 10). However, the ferroelectric random access memory device of Kweon does not include a flux concentrating layer, nor does it appear to use electroless plating. As such, there would be no reason to use the ruthenium seed layer of Molla in Kweon, and it is only by using Claim 1 as a roadmap that Kweon and Molla have been combined in the manner of the present rejections.

C. The Suggested Combination of Kweon and Molla Would Not Work

Applicants also submit that the device of Kweon would not operate properly if it were modified to include a ruthenium seed layer. Kweon teaches that the ruthenium lower electrode 28 "has an improved oxygen barrier characteristic [such that] it is possible to

prevent the seed layer 26 from being oxidized during a following thermal treatment that is carried out under the oxygen atmosphere." (Kweon at ¶ 0021). This subsequent thermal treatment is performed to oxidize the exposed portions of the seed layer 26 to form oxidized seed layer portions 26A that are insulating and hence will not effect the device characteristics. (Kweon at ¶ 0022). Our understanding is that a goal of Kweon is to provide such an insulating seed layer to avoid the need to perform an additional processing step to remove the seed layer. (See Kweon at ¶ 0001).

However, as indicated in Kweon, the exposed ruthenium layer 28 is not converted into an insulating layer during the annealing step in the oxygen atmosphere, as this layer acts as the lower electrode for the capacitor. (See Kweon at ¶P 0021-0022). Accordingly, if Kweon were modified to include the ruthenium seed layer of Molla as suggested in the Final Action, the ruthenium seed layer would likewise not be converted into an insulating layer during the anneal. As such, if Kweon was modified as suggested in the pending rejection, it would also appear necessary to also remove portions of the ruthenium seed layer, which is inconsistent with Kweon's stated goal of eliminating the need for such a step. As such, a skilled artisan would not modify Kweon as suggested in the Final Action.

II. The Dependent Claims are Also Patentable Over the Cited Art

Claims 2-14 each depend from Claim 1. Accordingly, these claims are each patentable over the cited art for at least the same reasons that Claim 1 is patentable. Moreover, Applicants also submit that at least Claims 6, 11, 12 and 14 are independently patentable over the cited art for the following reasons.

With respect to Claim 6, the Final Action states that Aaltonen discloses using H_2O_2 to form the ruthenium layer. (Final Action at 7). However, the last clause of Claim 6 recites that H_2 and/or NH_3 is used to form the ruthenium layer. H_2O_2 clearly is not H_2 or NH_3 , and hence the cited references fail to teach all of the recitations of Claim 6.

Claim 11 recites that "the dielectric layer comprises a tantalum oxide layer." The Final Action identifies that ferroelectric layer as comprising a "dielectric layer", and states that it would have been obvious to use a tantalum oxide layer instead of the ferroelectric layer. (Final Action at 5). However, the goal of Kweon is to provide a ferroelectric memory

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device, and Applicants' representative's understanding is that tantalum oxide is not a ferroelectric material. As such, the substitution suggested in the Final Action would not be an obvious one, as it would cause the device of Kweon to not work for its intended purpose.

The Final Action states that the recitations added by Claim 12 involve "mere duplication" that require "only routine skill" and hence are obvious. (Final Action at 6). However, forming an upper electrode is not "mere duplication" of forming a lower electrode, as is evident from Kweon's teaching that a seed layer is only used with respect to the lower electrode. Thus, the rejection of Claim 12 should also be withdrawn for at least this reason.

Claim 14 recites that "the ruthenium seed layer has an oxygen concentration of less than 5%." The Final Action states that such a concentration is not a critical dimension or that unexpected results arise therefrom. However, the specification teaches that high oxygen concentrations in the ruthenium layer may increase the contact resistance of a contact plug, and that the methods of the present invention may provide low oxygen content ruthenium layers that may facilitate reducing such an increase in the contact resistance. (Application at 2 and 8 and FIGS. 1 and 4). As such, Claim 14 is also patentable over the cited art.

For the above reasons, Applicants respectfully submit that the rejections of Claims 1-14 should be withdrawn.

Respectfully submitted,



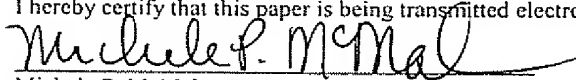
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